Space Weather Technical Forecast

Issued on Thursday, 22 June 2023 at 01:11 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: R1/R2 Radio Blackouts Likely throughout. Slight Chance of Minor Geomagnetic Storm G1 Days 1 & 2.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate in the last 24 hours, with a brief M1.1 flare observed at 21/1244UTC and originating from AR3341, the same region that produced an X1 flare on the 20th. However there was also an unexpected M1 flare observed at 21/1538UTC, originating from a new region near the north central meridian.

There are now up to fifteen sunspot regions on the disc, four of which are small and magnetically simple. AR3341 remains the most active following the X1 flare yesterday evening although it has recently simplified, now a Cao/Beta Gamma. AR3335 is the largest region overall but it remains stable and largely inactive. AR3342 remains large and magnetically complex but it is now approaching the SW limb and should rotate onto the far side in the next 24 hours. AR3344, in the NW quadrant, is growing in size and complexity but remains stable. It should be closely monitored though. The largest growth belongs to a region currently unnumbered near the north central meridian. This region came out of nowhere in a matter of hours, growing fast in size and complexity. It might become the main source of flare activity in the next 24 hours and should be closely monitored. All the other regions are stable or decreasing in size.

There are numerous filaments on the disc at present, as well as a seemingly unstable prominence on the north-eastern limb. Having said that, there is no evidence of any CME in coronagraph imagery. At present then, there are no new confirmed Earth-directed CMEs.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, showed an ongoing weak connection to a negative polarity coronal hole high speed stream, most likely originating from CH13. Solar wind speeds have been slightly elevated, gradually rising from 410 to 460km/s, briefly 480km/s. The solar wind density was mostly around average, while the IMF remained weak, below 8nT. The north-south component, Bz, was mostly positive but briefly fell to -7nT between 21/1930-2045UTC. The phi angle remained largely negative (towards the sun). The net effect of the above solar wind measures was Quiet with a provisional Unsettled interval in the 21-24UTC period.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as observed by GOES16, was at Background levels.

High energy electron flux (greater than 2MeV), as observed by GOES16, remained at Low and Moderate levels, narrowly approaching the High level during the diurnal peak. The associated 24-hour fluence was level at first but displayed a sharp fall during the second part of the UTC day, moving further away from the Active threshold. The observed fluence at 22/0001UTC was 3.58e7.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Moderate, with isolated or occasional M-class flares and a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: The geomagnetic forecast carries lower-than-average confidence. While mostly Quiet to Unsettled conditions are expected overall, there is a chance of an Active or even a slight chance of a G1/Minor Storm interval on Days 1 & 2 (22nd & 23rd), under the combined influence of the ongoing fast wind and also perhaps a glancing blow from some minor peripheral CMEs.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels, with a daily Slight Chance of S1 or greater.
High energy electron flux (greater than 2MeV) is expected to become confined to low and moderate levels, and the 24-hour integrated fluence to most likely remain under the Active threshold.

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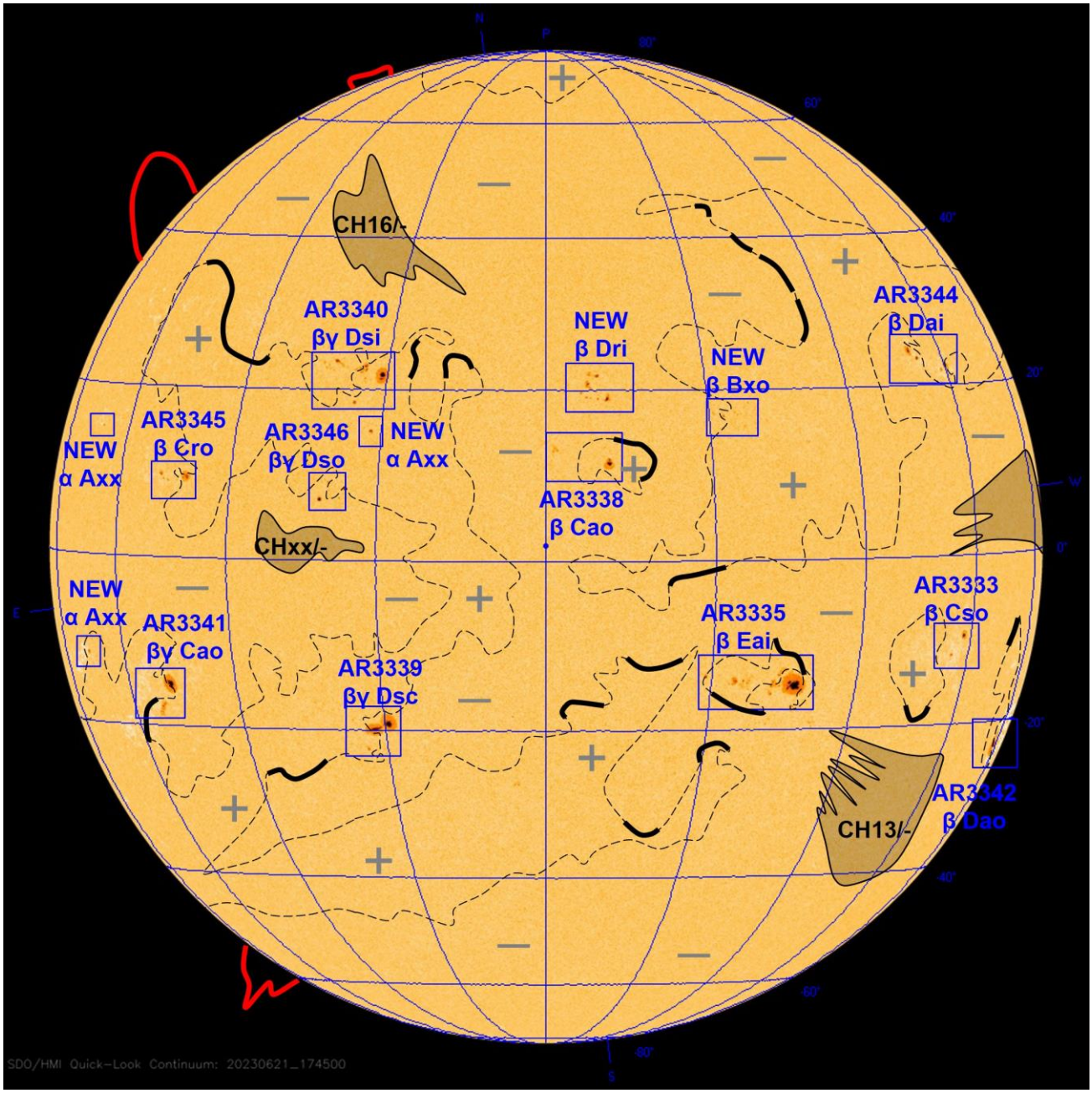
Figure 1. Solar Analysis Valid 21/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The geomagnetic forecast carries a low confidence for this period. This is due to coronal holes from this rotation being in different positions compared to the previous rotation, making persistence less reliable than usual.

Earth is currently under the influence of a weak high speed stream, most likely from negative coronal hole 13, with winds on a slight rising trend in the last 24 hours. This could be the result of the high speed stream alone. However there is a suggestion in the ensemble for one or two weak enhancements from peripheral glances the sun released several days ago. These are showing in the latest MOSWOC Enlil and ensemble output but the model has proved very volatile in this respect in recent runs, any weak glancing blows most likely on Day 1 and early on Day 2. No further Earth-directed CMEs have been observed in available imagery.

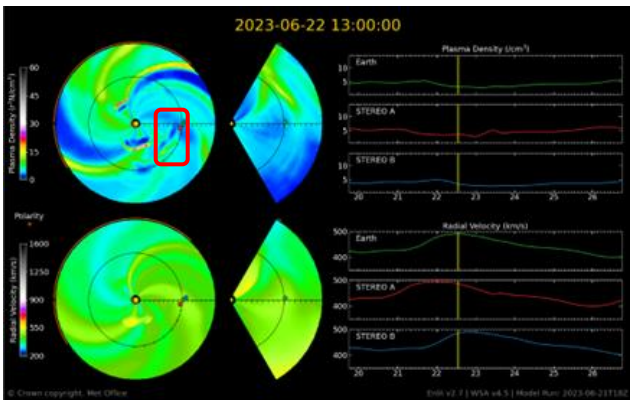
Solar winds are therefore expected to be slightly elevated or perhaps briefly elevated (500km/s) on Days 1 & 2, followed by a slow but steady decline on Days 3 & 4. While mostly Quiet to Unsettled conditions are expected overall, there is a chance of an Active or even a slight chance of a G1/Minor Storm interval on Days 1 & 2 (22nd & 23rd), under the combined influence of the fast wind and also perhaps a glancing blow from some minor peripheral CMEs.

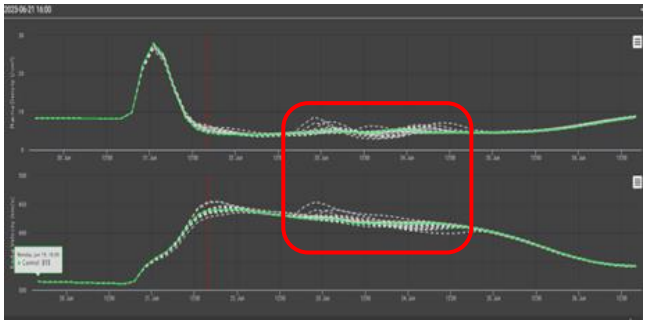
Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity – Earthbound Coronal Mass Ejections

Most likely NIL

Figure 2: MOSWOC Enlil and ensemble, showing minor influences from weak peripheral CMEs on the 22nd and 23rd





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Radio Blackouts - X-Ray Flares:
There are now up to fifteen sunspot regions on the disc, four of which are small and magnetically simple.

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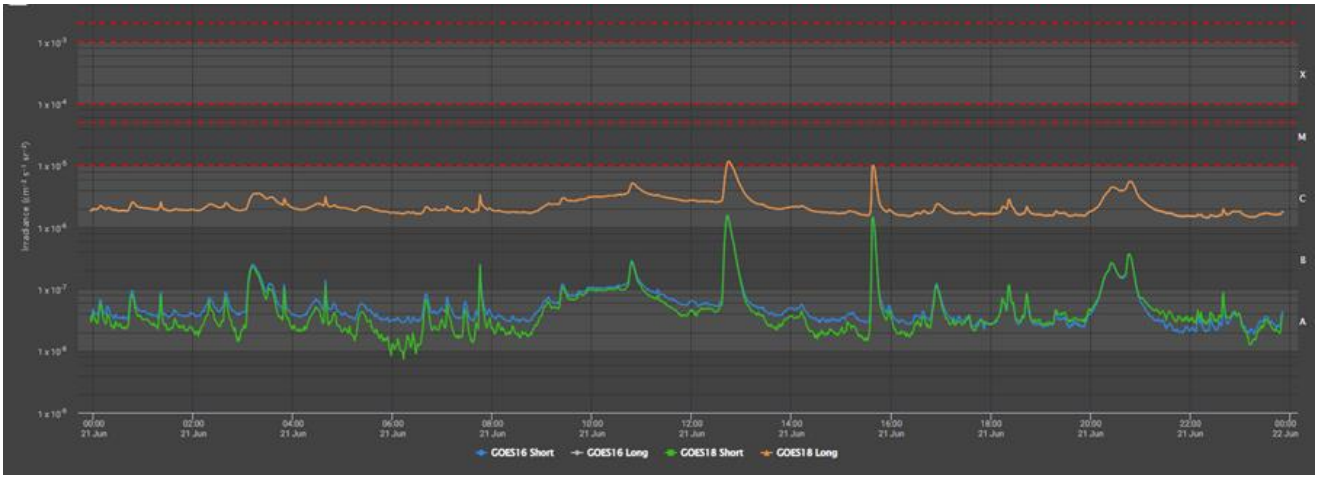
Solar activity is expected to remain Moderate, with isolated or occasional M-class flares likely and a slight chance of X-class flares, in part given the continued development of some regions, but also given the large number of active regions.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: Latest X-Ray Flare Activity, as observed from GOES-16



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux, as observed by GOES-16, is at Background levels and expected to remain so throughout the period. However, there is a daily slight chance of reaching the S1/Minor Storm threshold given the number and complexity of some sunspot regions. The risk is also considered to rise slightly over the following days, as some of the largest and most complex regions are currently on the eastern hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	15	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The upcoming forecast carries greater-than-average uncertainty given the number of possible minor interruptions from peripheral CMEs, as hinted at in the MOSWOC Enlil ensemble, which is proving volatile from run to run. There also remains uncertainties regarding the duration of slightly elevated solar winds, this is due to lack of reliable persistence data from previous rotations.

All considered and with an absence of significant geomagnetic activity over the following days, the high energy electron flux is most likely to become confined to low and moderate levels, the result being the fluence more likely than not to remain under the Active threshold and perhaps display a slight decreasing trend over time.

The latest MOSWOC REFM model output is considered to provide good guidance during this period, even though it currently over-estimates slightly the fluence levels.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	20	20	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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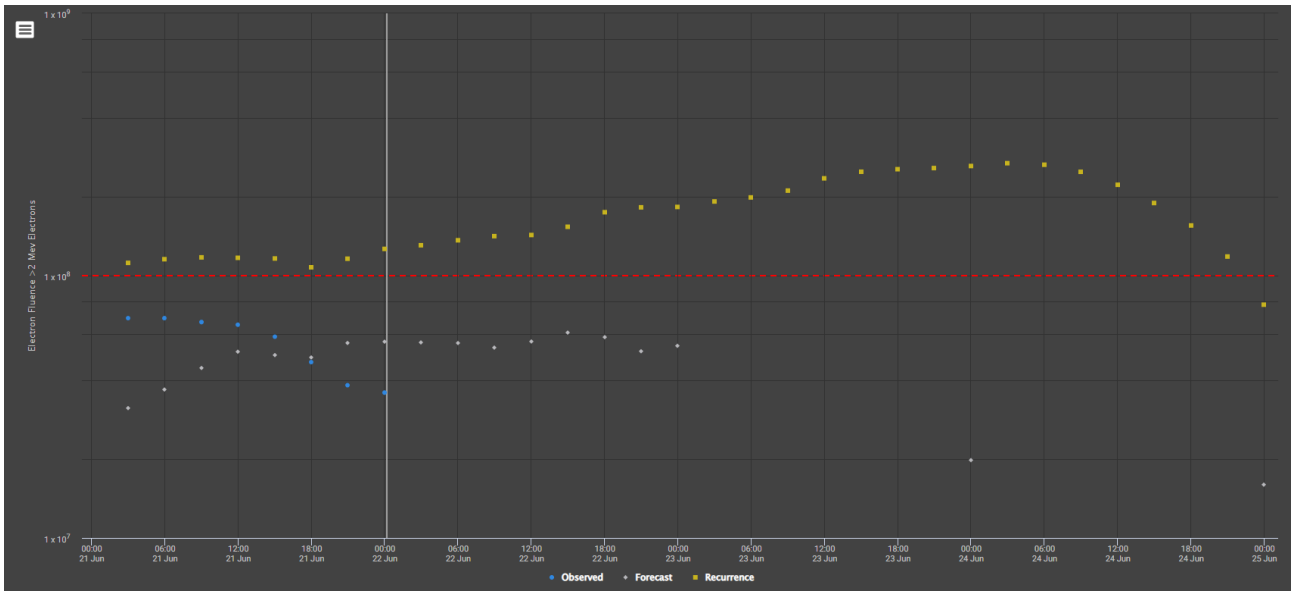
Figure 5: Latest REFM output



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